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LIST OF ABBREVIATIONS

ADC	-	Analog Digital Converter
AWR	-	Microwave Office
COMSOL	-	Multiphysics Finite Element Analysis Simulation Software
ESN	-	Electronic Serial Number
FDM	-	Finite Difference Method
FDTD	-	Finite Difference Time Domain
FEM	-	Finite Element Method
HFSS	-	High Frequency Structure Simulator
MATLAB	-	Math Lab
MIC	-	Microwave Integrated Circuits
MIN	-	Mobile Identification Number
MOM	-	Method of Moment
MTSO	-	Mobile Telephone Switching Office
RL	-	Return Loss
SID	-	System Identification Code
TM	-	Transverse Magnetic
VSWR	-	Voltage Standing Wave Ratio

LIST OF SYMBOLS

λ_0	- Wavelength
^{o}	- Degree
ε_r	- Dielectric constant
$\tan\delta$	- Loss tangent of the dielectric
L	- Length of the patch
W	- Width of the patch
L_0	- Length of the feed line
W_0	- Width of the feed line
L_g	- Length of the inset feed
W_g	- Width of the inset feed
$W_{eff}(0)$	- Static effective width
$W_{eff}(f)$	- Actual width of patch
L_e	- Actual length of patch
E_θ	- Electromagnetic Plane
E_ϕ	- Electric Plane
$J_i(x)$	- i^{th} order Bessel Function of the first kind
$U_i(x)$	- i^{th} order Bessel Function of the second kind
Y_m	- Mutual admittance between the radiating slot
Y_s	- Self admittance of the radiating slot
Y_0	- Characteristic admittance
Y_{in}	- Input admittance
Z_0	- Characteristic impedance
Z_{in}	- Input impedance
Z_L	- Load impedance
R	- Resistance

G	- Conductance
L	- Inductance
C	- Capacitance
R_{in}	- Input resistance
X_{in}	- Input reactance
Γ	- Reflection Coefficient
S_{11}	- Return loss in negative sign
$BW_{broadband}$	- Bandwidth in broadband
$BW_{narrowband}$	- Bandwidth in narrowband
f	- Frequency
f_r	- Resonant frequency
f_L	- Lower frequency
f_H	- Higher frequency
f_C	- Center frequency
h	- Substrate thickness
t	- Thickness of the metal
ε_{eff}	- Effective permittivity of substrate
$\varepsilon_{eff}(0)$	- Static effective relative permittivity
$\varepsilon_{eff}(f)$	- Frequency dependent effective relative permittivity
α	- Attenuation constant
β	- Phase constant
γ	- Propagation constant
$\vec{E}$	- Electric field intensity
$\vec{B}$	- Magnetic flux density
$\vec{D}$	- Electric field density
$\vec{H}$	- Magnetic field intensity
$\vec{J}$	- Current density
ρ_v	- Volume charge density
c_0	- Speed of light in free space
d	- Diameter of probe
ξ	- Euler-Mascheroni constant

μ_0	- Permeability in free space
ε_0	- Permittivity in free space
σ	- Conductivity
ΔL	- Extended length due to fringing effect
$\Delta \ell$	- Extended length due to fringing effect
η_0	- Intrinsic impedance of free space
k_0	- Wave number in free space
G_s	- Self conductance
B_s	- Self susceptance
G_m	- Mutual conductance
B_m	- Mutual susceptance
C_e	- Euler's constant
σ_s	- Conductance of the patch
σ_g	- Conductance of the ground plane
Δ_s	- Rms surface roughness of the patch
Δ_g	- Rms surface roughness of the ground plane
j	- Complex number
$si(x)$	- Sine integral of x
Q_T	- Total antenna quality factor
Q_d	- Quality factor of the dielectric
Q_c	- Quality factor for conductor
Q_r	- Quality factor for radiation
ω_r	- Angular resonant frequency
W_T	- Total energy stored in the patch at resonance
P_d	- Dielectric loss
P_c	- Conductor loss
P_r	- Power radiated from the patch
Δ	- Skin depth of the conductor
$\bar{\bar{G}}$	- Dyad
$\mathbf{E}(\boldsymbol{r})$	- Vector electric fields at **r**
$\mathbf{H}(\boldsymbol{r})$	- Vector magnetic fields at **r**
$\mathbf{J}(\boldsymbol{r'})$	- Vector source current distributions

$\mathbf{M}(\boldsymbol{r}')$	- Vector source current distributions
$\mathbf{E}_{le}\left(\boldsymbol{r}, \boldsymbol{r}', \mathbf{J}(\boldsymbol{r}')\right)$	- Vector electric fields at **r** radiated by the electric vector impulsive current
$\mathbf{E}_{lm}\left(\boldsymbol{r}, \boldsymbol{r}', \mathbf{M}(\boldsymbol{r}')\right)$	- Vector electric fields at **r** radiated by the magnetic vector impulsive current
$\mathbf{H}_{le}\left(\boldsymbol{r}, \boldsymbol{r}', \mathbf{J}(\boldsymbol{r}')\right)$	- Vector magnetic fields at **r** radiated by the electric vector impulsive current
$\mathbf{H}_{lm}\left(\boldsymbol{r}, \boldsymbol{r}', \mathbf{M}(\boldsymbol{r}')\right)$	- Vector magnetic fields at **r** radiated by the magnetic vector impulsive current

LIST OF APPENDICES